Title: Repeating Patterns, Repeating Patterns

Brief Overview:
In order to identify a non-numeric pattern, students should have the ability to identify the core and elements of the pattern. From this point they will be able to extend the pattern and repeat the core. Finally, students will apply their knowledge of patterns to real life situations.

NCTM Content Standard/National Science Education Standard:

- Understand patterns, and their relations and functions.
- Describe, extend, and make generalizations about geometric and numeric patterns.

Grade/Level:

Grade 3

Duration/Length:

3 days, 1 day for assessment (Day 1 and Day 2 - 60 minutes, Day 3—time for review plus 15 minutes for the assessment)

Student Outcomes:

- Students will be able to duplicate a pattern with snap cube manipulatives.
- Students will describe a given snap cube pattern.
- Students will be able to extend the pattern.
- Students will make generalizations on how repeating patterns are created.

Materials and Resources:

Lesson 1
- Geometric shapes (hexagon, triangle, rhombus, parallelogram, and a square)
- Overhead projector
- Description of a geometric pattern
- Checklist for assessment—2 copies needed
- Crayons and colored pencils
- Bags of snap cubes - 20 bags of 10 green cubes and 10 blue cubes in a bag 20 bags of 10 brown cubes and 10 red cubes in a bag
- Bags of geometric blocks (8 hexagons, 8 triangles, 8 squares, 8 parallelograms per bag)
- Descriptions of patterns
- Overhead projector

- Computer website: Using geometric shapes
  http://standards.nctm.org/document/eexamples/chap4/4.1/Part2.htm

  Using colored blocks
  http://standards.nctm.org/document/eexamples/chap4/4.1/index.htm

Lesson 2

Sheets of 10x10 grid chart paper
- Dry erase marker
- Bags of shapes to students (8 rhombuses, 8 hexagons, 8 triangles, and 8 squares per bag)
- Word problems to make rug patterns—2 copies needed

Day 3
- Student assessment
- 8x8 chart paper

Development/Procedures:

Lesson 1

Pre-assessment

- State the objective: Students will identify the core and elements of patterns in order to extend the pattern.
- Have the students repeat a clapping pattern you give them. For example, you clap 1-2-3-4, and they should clap 1-2-3-4. Next, you clap 1,2,--3,4, they clap 1,2,--3,4. Repeat this activity by having the students stomp there feet and pound their desks in a pattern.
- Next show the following shapes on an overhead projector: hexagon, triangle, rhombus, parallelogram, and a square and have the students identify the name of each shape.
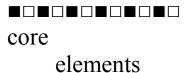
Launch

- Ask for four student volunteers, two boys and two girls. Ask them to line up boy-girl-boy-girl. Ask the rest of the class to guess what the core of the pattern is (they should say boy-girl-boy-girl). Call on volunteers to extend the pattern without talking.
- Next have the class sit at their desks. Have the students work in groups of four. Distribute crayons and colored pencils to each group. Have the groups line colored pencils and crayons parallel to each other in order to create similar patterns. Have the students identify the core and the elements in their patterns. Below is an example that is similar to what the students should create.

C = colored pencil
R = crayon   C,R,C,R,C,R,C,R,C,R

Teacher Facilitation

- **(Pre-made bags of snap-cubes: 10 green and 10 blue in one bag, 10 brown and 10 red in another bag. Assemble 20 bags of each combination.)** Distribute bags of snap-cubes. Model on an overhead projector 8 cubes, with a green cube followed by a blue throughout the 8 cubes. Below is an example that may help you.

- G = green
  B = blue G,B,G,B,G,B…..

- Draw a bracket under the first 4. Give students time to put together what you are showing them. Under the bracket, write the word, "core". Tell students the core is the start or the base of a pattern. Under the word core, draw arrows pointing to all of the cubes and write the word "elements." Tell the students the elements or the terms, are the objects that make the pattern.

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  core
          elements

- Repeat the same activity with red and brown cubes. Show students a group of four red and brown cubes, with a red cube followed by a brown cube. Do the same thing you did with the green and blue cubes. Have students extend it by six elements on their own. Have the students draw the patterns they made with the cubes and label the core and elements on their paper.

Student Application

- Distribute bags of geometric blocks (8 hexagons, 8 triangles, 8 squares, 8 parallelograms per bag).
- Display **Teacher Resource 1** on the overhead projector: This pattern has three elements in its core. None of the shapes are the same. Two shapes have more sides than the third. None of the shapes has six sides or more. Repeat this core for three rows so you can see the layout of the shapes. Describe what you see (Patterns may vary. Students should choose one triangle and two different quadrilaterals).

- Model how to use the clues to create the pattern. Using the description from above, show students how you started with a core: a triangle, a square, and a trapezoid. Repeat the core once. Have students copy what you have and extend it. Repeat with a core consisting of a parallelogram, square, and a triangle. Have students work in pairs to create repeating patterns. Distribute **Student Resource 1.** (Description cards). Cut out each box, and distribute one box to each pair of students. Each pair will complete one activity.

Embedded Assessment

- Observe to see who can follow the directions on the descriptions correctly. The students should write what they see in the patterns. Have them write about the core and the elements. Use **Teacher Resource 2 (checklist) to record student assessment.**

Reteaching/Extension

- Computer program (e-examples)
  Using geometric shapes
  http://standards.nctm.org/document/eexamples/chap4/4.1/Part2.htm

  Using colored blocks
  http://standards.nctm.org/document/eexamples/chap4/4.1/index.htm

- Students can use either of the two websites. On the first website (geometric shapes), students can make patterns with geometric shapes. They can change the core and extend the pattern to see what design they can make. On the next website (colored blocks), students can make a pattern with colored blocks and determine how many blocks will be in their core in order to make a diagonal or vertical pattern.

- Pull those who are struggling into a small group and work with smaller cores. For example, give each student 5 triangles and 5 squares. Have them make a core of a triangle followed by a square. Repeat it once. Then have the children extend it. Then change the core and tell them to start with a square, then a triangle and extend it.

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Lesson 2

Pre-assessment

- Review the terms: core and element. Using a dry erase marker, draw a pattern of a blue triangle followed by a yellow square which is followed by a blue triangle. Distribute paper and crayons, have students extend the pattern. Ask: What is the core of the pattern? (Answer: blue/yellow/blue/yellow)
  Which blocks make the core? (Blue triangle, yellow square)
  Ask: What are the elements of the pattern? (Blue triangle, yellow square).
  Make another core of shapes on the overhead. Have the students extend the pattern.

Launch

- Use **Teacher Resource 3** large 10x10 square grid paper. Draw and model a core: rhombus, hexagon and a square. Extend the core; repeat the pattern for three rows on the 10x10 grid.
  Ask: What do you observe about this pattern? (It's repeating and it shows shapes in a diagonal line).
  Ask: Do you see the same shape at the end of each row? (No) Why or Why not? (The core is not complete at the end of each row, causing the same blocks on consecutive rows to line up diagonal to each other.)

- Follow the same procedure you did with the rhombus, hexagon and square.
  Model a repeating pattern and change the core to include 4 different elements.
  Ask: How has the pattern with 3 core elements changed to that of 4 core Elements? (has a checkered pattern)
  Why do the two patterns look different? Describe the new pattern.
   (On a 10x10 grid a three-core group is only off by repeating itself by one, causing similarly colored blocks to be diagonal to each other. With a core group of 4 the 10x10 grid cuts the core in half at the end, causing the similarly colored blocks to repeat in every other row-causing a checkered pattern.)

Teacher Facilitation

- **Distribute chart paper and colored pencils.** Distribute bags of shapes to Students. Tell the students to use the rhombus, hexagon, triangle and square to create at least 2 different repeating patterns. Have them extend the pattern to see what it looks like. Their first pattern should have a core

of: rhombus, hexagon, triangle and square.   Ask them to describe in words what the design looks like. Then have them change the first core, to a core of three with a different sequence of blocks. Once they change the pattern, ask how the design of their second core looks different from the pattern with the core of 4. Have the students make two more patterns, one with the core of three and one with a core of 4 shapes. Repeat each cores three times. Ask how the different number of shapes in a core affects the design.

Student Application

- Show the students a green-red-green-red pattern. Extend it for three rows so you can see vertical lines. Ask the students why and how those vertical lines are made (Have students understand that at the end of every row, the core is complete.   Therefore, the same colored blocks line up under each other on the following rows). Next make a core of, green-pink-blue and extend it to see the design. Ask the students if the same color is at the end of every row? Why? (At the end of every row, the core of three is incomplete. There is an extra block, causing the colors to line up diagonally.) Ask: Does the core need to be complete at the end of every row to make vertical lines? (Yes) Ask how many blocks are in a core to make diagonal lines? (Three)

Green	Red	Green	Red	Green	Red
Green	Red	Green	Red	Green	Red

Green	Pink	Blue	Green	Pink
Blue	Green	Pink	Blue	Green
Pink	Blue	Green	Pink	Blue

- Have students work in groups of four. Cut apart the boxes from **Student Resource 2** before you distribute the problems. Give each group a box from **Student Resource 2**. Tell them each group has instructions on a type of rug pattern to create. Each group needs to figure out the core that is necessary to make the rug pattern. The same rug problem can be given to different groups.

Embedded Assessment

- Observe the students and the checkered patterns they make. Use **Teacher Resource 2**. As the students perform correct operations, check off items on the checklist.

Reteaching/Extension

- Using geometric shapes

http://standards.nctm.org/document/eexamples/chap4/4.1/Part2.htm

- Using colored blocks
  http://standards.nctm.org/document/eexamples/chap4/4.1/index.htm

- Students who are struggling, may make a group of 2 like-colored blocks, then a group of 4 of the same color, then 6.   Have them determine how many blocks will be in the next group. Repeat with 4.
- Use snap cubes to make a rug-type pattern. Snap cubes together to form an actual rug.

Day 3

- Have students sit at their own desks. Distribute **Student Resource 3** – the summative assessment for the lesson. Pass out 8x8 chart paper as needed for the test. Use **Teacher Resource 4** to grade the tests.

Appendix A: Teacher Resources

       Teacher Resource 1: Pattern Description
       Teacher Resource 2: Checklist –2 copies needed
       Teacher Resource 3: 10x10 Grid Paper
       Teacher Resource 4: Answer Key to Summative Assessment

Appendix B: Student Resources

       Student Resource 1: Descriptions of Geometric Patterns
       Student Resource 2: Word Problems for Rugs—2 copies needed
       Student Resource 3: Summative Assessment
       Student Resource 4: 8x8 Grid Paper

References

What's My Pattern?

http://www.lessonplanspage.com/MathPatternsUsingComputerAndUnifixCubesP2.htm

Authors:

Dan Schrot	**Samuel Fatokun**
Cooper Lane Elementary School	**Thomas Stone Elementary School**
Prince George's County	**Prince George's County**

Pattern Description

This pattern has three elements in its core.

- None of the shapes are the same.
- Two shapes have more sides than the third.
- None of the shapes has 6 sides or more.
- Repeat this core for three rows so you can see the layout of the shapes.

Questions for discussion:
How are the shapes aligned?
- Does each row end with the same shape?